

Some Facts About Inorganic and Organic Chemicals, and Radionuclides

Inorganic Chemicals

Inorganic chemicals include metals, and nitrates and nitrites. While many metals are essential to life, practically all are toxic in excessive quantities. Some metals, such as lead, are toxic in very small quantities.

Metals in the environment are commonly absorbed and concentrated by plants and animals. This can be dangerous for humans if they eat the plants and animals. However, after plants absorb metals from contaminated soils, the plants can be harvested and safely disposed of, removing the absorbed metals from the environment. This is a cleanup technology currently being used at the INEEL.

Nitrates and nitrites are simple compounds of oxygen and nitrogen. These compounds are a constituent of animal waste, a common fertilizer and byproducts of many industrial processes. Nitrates are also an end-breakdown product for many nitrogen-containing chemicals.

Organic Chemicals

Organic chemicals are chemicals containing carbon. All known life forms are based on organic chemicals. Common products containing organic chemicals include gasoline and alcohol.

Many organic chemicals are readily absorbed by internal body tissues. Because the liver is the human body's major site for chemical breakdown, some organic chemicals can cause serious liver damage and increase the likelihood of liver cancer.

Many organic chemicals are almost completely insoluble in water; they will either float or sink depending upon their density relative to water. For example, gasoline floats on the surface of water in a thin film; trichloroethene sinks.

Radionuclides

Radionuclides are radioactive forms of elements. For example, iodine-129 is a radioactive form of iodine. Tritium is a radioactive form of hydrogen that is usually found as a component of water. Radionuclides are a special case of inorganic chemicals and are easier to detect in minute quantities due to their radioactive properties.

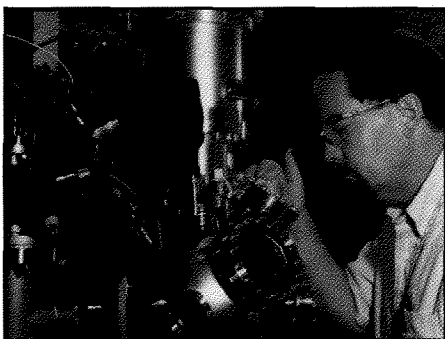
Radionuclides decay (emit radioactivity) at predictable rates called half-lives. A half-life is the time it takes for one half of the atoms in a quantity of a radionuclide to decay. After the first

half-life, 50 percent of the atoms have decayed; after the second, 75 percent have decayed; and so forth. After seven half-lives, less than 1 percent of the radionuclide remains in its original form. The decayed form that remains can be either another radionuclide or a non-radioactive substance.

Radionuclides, like all contaminants, can be inhaled as dust or ingested in food and water. Though some studies indicate low doses of radiation can have beneficial effects, radionuclides can damage the genetic material in cells and lead to cancer.

Water containing tritium is almost identical to ordinary water except that it is radioactive and slightly heavier. Though there is no practical cleanup method to separate tritium-containing water from ordinary water, a quantity of tritium-containing water will contain less than 1 percent of its original radioactivity after an 86-year period (seven half-lives).

The radionuclides cesium-137 and strontium-90 are often found in equal proportion close to sources of contamination at nuclear facilities. At the INEEL, cesium-137 binds strongly to the rock, while strontium-90 does not. So, as the distance increases from a source of contamination, the proportion at which the two radionuclides are found rapidly rises in favor of strontium-90. This characteristic is useful in determining a contamination source.



Ongoing subsurface science research uses secondary ion mass spectrometry (SIMS) instrumentation to analyze the mobility of plutonium and other radionuclides.

Why isn't plutonium listed as an aquifer contaminant at the INEEL?

The discussion in this factsheet focuses on those INEEL contaminants that consistently exceed drinking water standards, posing a reasonable threat to the aquifer.

Though there is a perception that plutonium is a groundwater contaminant at the INEEL, current research and modeling shows that plutonium is not a threat to the aquifer. There have been isolated and inconsistent trace detections of plutonium in sedimentary interbeds and in the aquifer. However, they are

near the scientific limits of detection (360 times below the drinking water standard). These detections are inconsistent with current understanding of how plutonium moves in the environment.

Ongoing scientific research is examining plutonium's chemical nature and mobility in the subsurface. Based on current scientific understanding, plutonium poses no risk to aquifer quality in the present or the foreseeable future.

Subsurface Science Initiative Focuses on DOE's Most Challenging Problems

The INEEL established the Subsurface Science Initiative to help the DOE better understand and model the complex geological, geochemical, biological and hydrological processes of the subsurface.

Not only are the majority of DOE's difficult cleanup issues related to subsurface contamination, but the

proposed final resting place for most stabilized waste will be in subsurface repositories or disposal areas. Increasing our understanding of subsurface processes is a critical part of this cleanup effort.

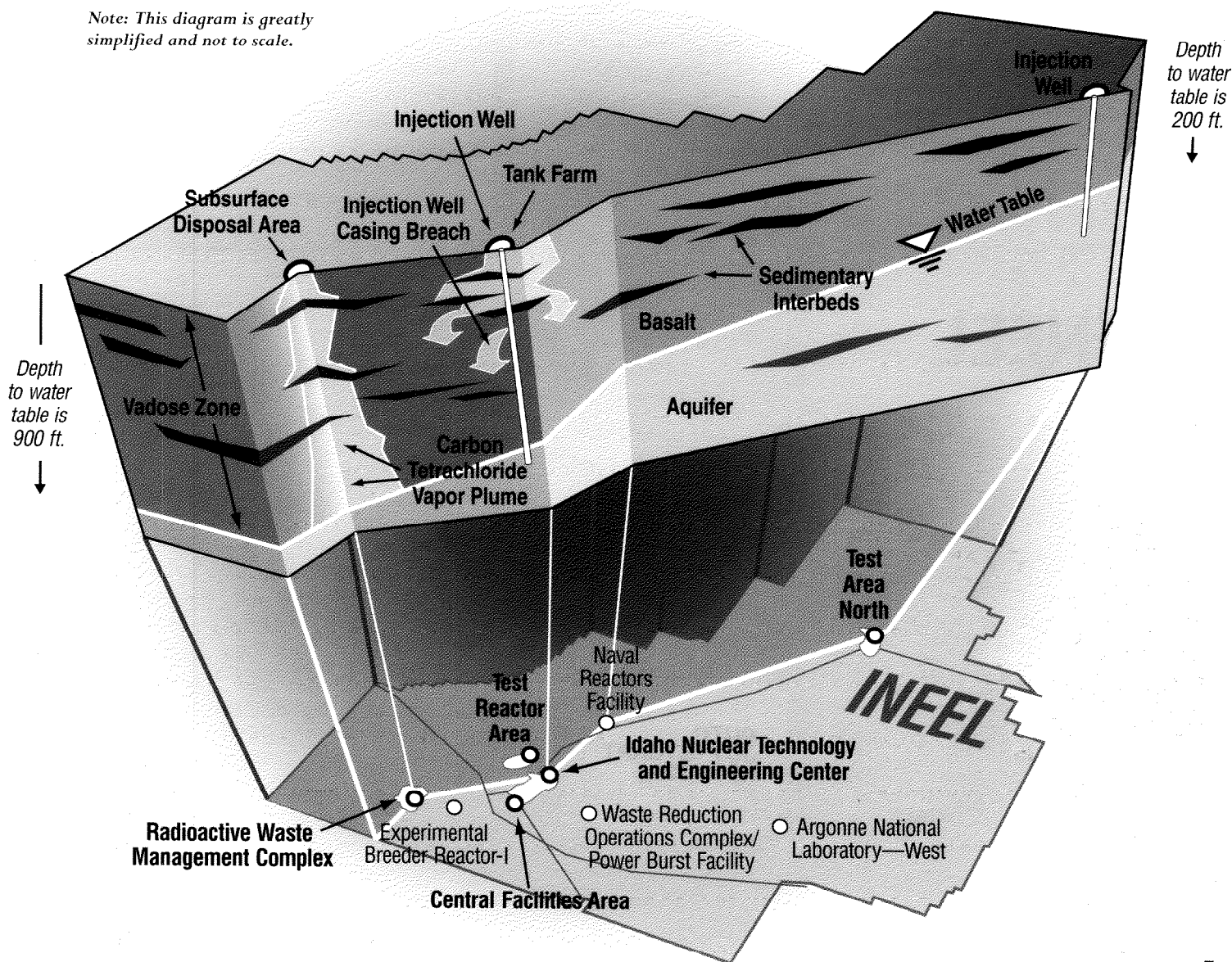
The INEEL's Subsurface Science Initiative is a coordinated, multi-disciplinary, multi-institutional collaborative research program. The Initiative focus on wide-reaching research campaigns, and also on building the technical and experimental infrastructure—such as the planned Subsurface Geosciences Laboratory—

needed to advance subsurface science.

The INEEL Subsurface Science Initiative is focusing collaborative research efforts on the most challenging subsurface science problems facing DOE. The objectives are to substantially enhance the scientific basis of environmental remediation programs at the INEEL and across the DOE complex, and to provide better options for monitoring and long-term stewardship of contaminated sites.

This cross-section of the INEEL shows the basic geology of the aquifer and most of the sources of groundwater contamination. Facilities with groundwater contamination are shown in boldface.

Note: This diagram is greatly simplified and not to scale.



Information

- For information on specific documents, speakers, briefings, tours, public meetings, and comment periods, call (800) 708-2680.

1-800
708-2680

- For information on environmental topics, call (208) 526-0075 (Idaho Falls) or (208) 334-9572 (Boise)
- INEEL home page: <http://www.inel.gov>
- INEEL Environmental Management page: <http://www.inel.gov/environment>

www.inel.gov



- The INEEL Administrative Record (documents and source materials) is available at <http://ar.inel.gov/home.html> and at the following locations:

INEEL Technical Library

DOE Public Reading
Room

1776 Science Center
Drive

Idaho Falls, ID 83415

208-526-1185

Albertsons Library

Boise State University

1910 University Drive

Boise, ID 83725

208-385-1621

University of Idaho Library

University of Idaho
Campus

434 2nd Street

Moscow, ID 83843

208-885-6344



INEEL Environmental Restoration Program

MS 3206

P.O. Box 1625

Idaho Falls, ID 83415-3206

Address Service Requested

References

- *Groundwater at the INEEL*, a more extensive fact sheet available for download at <http://www.inel.gov/environment>
- The U.S. Geological Service (USGS), Water Resources Division, Idaho District, <http://idaho.usgs.gov/>
- The U.S. Environmental Protection Agency (EPA) Office of Groundwater and Drinking Water, at (800) 490-9198, <http://www.epa.gov>
- The INEEL Oversight Program, which monitors water quality of the Snake River Plain Aquifer, at (800) 232-INEEL.

Publications

- *Summary of the Snake River Plain Regional Aquifer-System Analysis in Idaho and Eastern Oregon*. G. F. Lindholm, U.S. Geological Survey (USGS) Open-File Report 91-98, 1993, Boise, Idaho.
- *Upper Snake River Basin Study*, 1997. Idaho Department of Water Resources, 1301 N. Orchard Street, Boise, Idaho, 83720.
- *Risk Assessment in Superfund: A Primer*, an EPA guide to risk assessment, available in Binder 300 of the Information Repositories, or by calling the EPA at (206) 553-6901.

**PRSRT STD
U.S. POSTAGE
PAID
IDAHO FALLS, ID
PERMIT NO. 73**

Things to Know **About the INEEL and the Aquifer**

INEEL activities have NOT put off-site drinking and irrigation water in the Snake River Plain Aquifer at risk.

- INEEL activities have resulted in on-site aquifer contamination but presently pose NO risk to off-site drinking or irrigation water.
- INEEL and other independent agencies, including the state of Idaho and USGS, regularly monitor aquifer quality at hundreds of wells across the site.

The INEEL has been taking actions to address aquifer and groundwater contamination.

- Aquifer cleanup activities are underway and are subject to approval by the state of Idaho and the EPA.

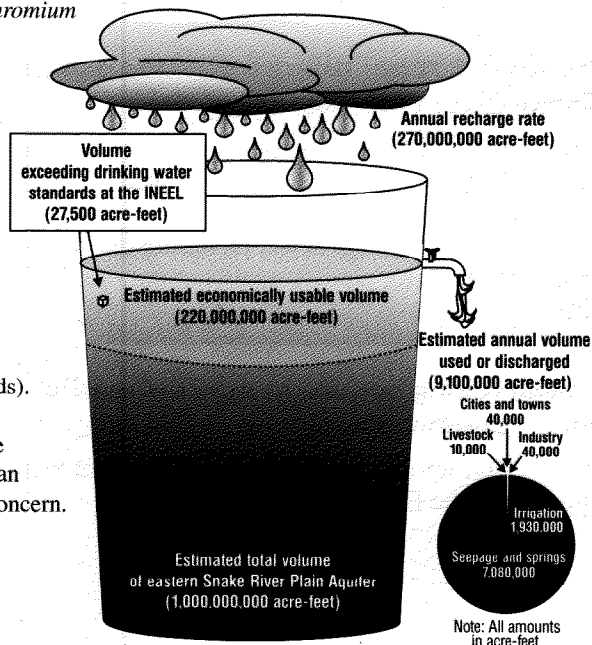
The Facts

Of the hundreds of chemicals DOE monitors, only 10 chemicals are found in the aquifer at levels that would exceed federal safe drinking water standards:

- Organics—*PCE, TCE, DCE and Carbon Tetrachloride*
- Radionuclides—*Strontium-90, Cesium-137, Iodine-129 and Tritium*
- Inorganics—*Nitrate, Chromium*

Water consumed by INEEL employees meets drinking water standards.

The detection of plutonium in the eastern Snake River Plain Aquifer has been isolated, inconsistent and near the scientific limits of detection (360 times below safe drinking water standards). Understanding plutonium movement in the subsurface is a scientific question, not an environmental or cleanup concern.

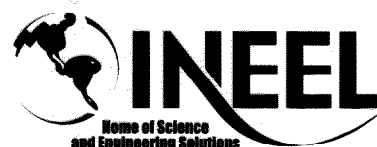


Contact Information:

For information on briefings, speakers, specific documents, tours, public meetings and comment periods, call (800) 708-2680

Stacey Francis
(208) 526-0075
syf@inel.gov

www.inel.gov/environment



This fact sheet was prepared to answer public questions about groundwater at the INEEL. Please let us know if it met your informational needs or if you would like more information.

I would like more information about the INEEL and its programs. Please send me information about (check all that apply):

☐ INEEL Research Programs

- ☐ Energy and Nuclear Research
- ☐ National Security Research
- ☐ Subsurface Science and Environmental Research

☐ Environmental Management and Cleanup Programs

☐ My group or organization would like more information on this topic and would like to schedule a briefing. Please contact me to make arrangements.

Name: _____

Organization (if any): _____

Address: _____

City, State, Zip: _____

Email address: _____

☐ I prefer to receive information by email.

☐ I prefer to receive information by postal mail.

☐ I would like to receive both email and postal mail.

Please evaluate this fact sheet:

- ☐ Met all of my information needs
- ☐ Met most of my information needs
- ☐ Met some of my information needs
- ☐ Met none of my information needs
- ☐ Raised more questions than it provided answers

For information on environmental topics including specific documents, speakers, briefings, tours, public meetings and comment periods, call (800) 708-2680 or visit the web site at **www.inel.gov/environment**.



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST-CLASS MAIL PERMIT NO. 61 IDAHO FALLS, IDAHO

POSTAGE WILL BE PAID BY ADDRESSEE

STACEY FRANCIS
MS 3206 NLLWMP
IDAHO NATIONAL ENGINEERING LABORATORY
P O BOX 1625
IDAHO FALLS ID 83403-9987

